IGOS
Integrated Global Observing Strategy

IGOL: The Land Theme

Integrated Global Observations for Land:

The need for a Land Theme

- IGOS-P had not considered the observational needs relating to many aspects of the land
  - Sustainable economic development,
  - Natural resources management,
  - Conservation and biodiversity
  - Ecosystems
    - Functioning
    - Services
  - Multilateral environmental agreements.
    - development, implementation mandatory reporting and monitoring.
- The World Summit on Sustainable Development pointed to the need to *"Promote the development and wider use of earth observation technologies, including satellite remote sensing, global mapping and geographic information systems, to collect quality data on environmental impacts, land use and land -use changes."*

IGOL Partners

Sponsors

Technical inputs (includes)

IGOL Team members

Co-chairs

- John Townshend (GOFC-GOLD)
- John Latham (GTOS)

- Olivier Arino CEOS, ESA
- Roberta Balstad CIESEN
- Alan Belward GCOS
- Richard Conant NREL
- Driss El Hadani CRTS, Morocco
- Chris Elvidge CEOS/NOAA
- Jay Feuquay CEOS/USGS
- Anthony Janetos Heinz Center
- Chris Justice GTOS/GOFC-GOLD
- Jiyuan Liu CAS
- Tom Loveland CEOS/USGS
- Martha Maiden CEOS/NASA
- Dennis Ojima IGBP
- Christiana Schmullius GTOS/GOFC-GOLD
- Ashbindu Singh UNEP
- Jeff Tschirley FAO
- Hirokazu Yamamoto JAXA

Special Meetings

Agriculture	Conservation and Biodiversity	Chinese Input

Agriculture

IGOS Integrated Global Observing Strategy

IGOL

AGRICULTURAL MONITORING MEETING CONVENED FOR THE INTEGRATED GLOBAL OBSERVATIONS FOR LAND (IGOL) THEME

Rome, Italy

8-11 March 2006

June 28, 2006

Conservation and Biodiversity

CBD, UNEP-WCMC, FAO, WRI, WCS, CI, WWF, NatureServ, Heinz Center, USGS, NASA, CSIR

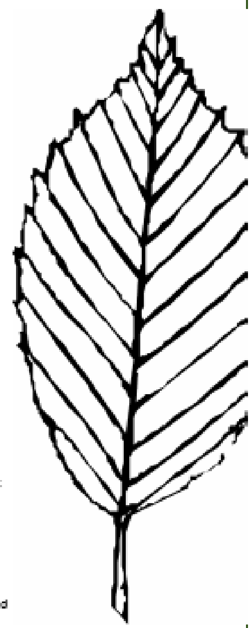
Integrated Global Observations of the Land (IGOL)
– an IGOS-P Theme

Special meeting on observational priorities for conservation and biodiversity

3rd-4th November 2005

THE HEINZ CENTER Hosted by the H. John Heinz III Center for Science, Economics, and the Environment Washington DC

Meeting co-Chairs: Anthony C. Janetos, The Heinz Center
John Townshend, University of Maryland



GTOS

Food and Agricultural Organization of the United Nations, Rome, 2006

Chinese Input

Special IGOL Meeting: To Obtain Chinese input on the development of the IGOL Theme Report

3rd September 2005
Institute for Geographical Sciences and Natural Resources, Beijing, China

Co-Chaired by
Professor Liu Jiyuan and
Professor John Townshend

Vision for EO contribution to crop growth monitoring

Spatial resolution

EO 1 km — 150-300 m — 10 m

Revisiting capabilites giving 1 to 2 useable images every 10 days

Area

Entire region

Croplands mask
6 wks after sowing

Crop type at parcel level
3 months after last sowing

Crop Growth

Overall Veg'n growth

Agriculture Veg'n conditions

Crop specific conditions

Crop variables Crop stages

Anomalies assessment

every 10-days

Crop growth model

every 5 to 10-day for critical period

Yield estimation

every 5 to 10-days

Validation data set required to extend current local research results

Report Structure

- 1. Introduction
- 2. Needs for IGOL
- 3. Stake-holders
- 4. Products and Observables needed
- 5. Integration issues
  - Validation and quality assessment
  - Data fusion
  - Data assimilation
- 6. Data Delivery
  - Data and product access
  - Data policies
- 7. Capacity building
- 8. Relation of IGOL to other Themes
- 9. Implementation

Needs and observables

- The needs for IGOL
  - Agriculture
  - Forestry
  - Land degradation
  - Ecosystem goods and services
  - Biodiversity and Conservation
  - Human health
  - Water resource management
  - Disasters
  - Energy
  - Urbanization: sustainable human settlement
  - Climate Change
- Observables and Products
  - Land cover land cover change
  - Land use land use change
  - Biophysical properties relating to ecosystem dynamics
  - Fire
  - Biodiversity and conservation
  - Agriculture
  - Soils
  - Human settlements
  - Water availability and use
  - Topography

Recommendations

- **Land cover land cover change**
  - Coordinate radar and optical data acquisition so that radar data can be used for regular, global monitoring of land cover.
  - Move to annual cycle
- **Land use land use change**
  - Key product
  - GEO involvement not yet comprehensive.
- **Biophysical properties Relating to ecosystem dynamics**
  - Mod resolution OK
  - Fine resolution requires increased frequency needed.
  - In situ coord. major task - ILTER
- **Fire**
  - Geostationary capability
  - Initiate an international program on Global Fire Early Warning, integrating satellite and in situ fire weather data.
- **Biodiversity and conservation**
  - Demand for ultra-high resolution data on demand
  - Protected areas
- **Agriculture**
  - Provide fine resolution (10-20m), cloud free coverage with a 5-10d return period.
- **Soils**
  - Recommendations long-standing
- **Human settlements**
  - Increased use of ultra-high resolution data
  - Provide enhanced spatial resolution and multiple spectral bands from low light imagery.
  - Improved utilization of census data for grided population data
- **Water availability and use**
  - Enhance methods to model water use/demand on the watershed scale.
  - Map irrigated land area using high and moderate resolution remotely sensed data.
- **Topography**
  - 30 m spacing globally
  - Improved vertical resolution coastal and flood plains

Recommendations

- Many different types of users.
  - Drive different sets of requirements:
  - No single unifying concept like global carbon or hydrological cycles.
- Important not to over-simplify:
  - Fine resolution requirements for *land cover change* – 16 day repeat cycle OK.
  - Fine resolution requirements for *agriculture* likely at least 8 day repeat cycle.
  - For *Agricultural NPP* probably daily coverage required.
- Issues relating to Earth Observation
  - Technical specs of sensors and repeat cycles
  - Acquisition strategies (including linked acquisition strategies for multiple sensors).
  - Product types
  - Validation *(unvalidated products should not be generated)*
  - Distribution policies

Status of remote sensing observations?

Status of some key terrestrial observing systems

- Large numbers of mission in orbit.
- Many have no continuity planned.
- Many have poor data policies and weak distribution.
- Overall cooperation in use satellites is weak compared with weather satellites.

	Technical Challenge	Continuity Challenge	Availability Challenge
Ultra-fine resolution	**No**	Probably not	Y
Fine Res	**No**	Y now	Y
Thermal	**No**	Y	Y
Mod Res.	**No**	**No**	**No**
Radar	**No**	Y	Y
Canopy Lidar	Y	Y	Y
City Lights	**No**	Y	Y

In situ observations

- In situ observations dealt with less comprehensively than remote sensing observations.
  - Most of the latter are collected with national or local needs
  - Standardization of collection procedures often not adhered to, nor is there often a tradition of freely exchanging data.
  - Need for improved in situ data collection occurs throughout the report and notably for biodiversity, agriculture, soils and fires.
- Improved standardization of in situ data
  - national fire data collection and reporting
  - adoption of international standards for in situ data relevant to agriculture.
- Continuing efforts will be needed by the various terrestrial communities to make data available.
  - call for improved data exchange standards for several biophysical variables to improve their availability.
- Greater integration of in situ and satellite observations
  - Notably forestry and agriculture
  - DA in general.

Implementation of Sub-Themes

Sub-Theme	Status	Bodies carrying out tasks
Land Cover	Largely transitioned to GEO: DA-07-02 & 03	GEO, GOFC-GOLD, FAO/GTOS, CEOS etc
Land Use/ Change	Ag LU transitioned to GEO: GEO needs a more comprehensive global LU activity.	GEO, GOFC-GOLD and FAO/GTOS
Fire	Partly transitioned to GEO: DI-06-13	GOFC-GOLD and FAO/GTOS
Biodiversity/Conservation	Report submitted to GEO	GEO, CBD, WHC etc.
Agriculture	Transitioned to GEO: AG-07-03	GEO, IGOL Ag Team with FAO

Implementation of Sub-Themes

Sub-Theme	Status	Bodies carrying out tasks
Biophysical Properties (relating to Ecosystem Dynamics)	Many remote sensing needs correspond to GIP; in situ needs development. Regional: GEO Task: EC-06-07.	-GCOS/CEOS for RS; -GEO Ag NPP - In situ: Fluxnet. - Ecosystem props TBD.
Soils	On-going	FAO; ISRIC
Human Settlement /Socio-Economic Data.	Needs development. Note IGOL will include population.	Needs additional international coordination.
Water Availability & Use,	Introduced by FAO: needs more development	FAO + Water Theme
Topography	Main recommendations unlikely to change	GEO task on-going

GROUP ON EARTH OBSERVATIONS

FIRST NOTICE

Workshop to develop a Strategy for Global Agricultural Monitoring in the framework of Group on Earth Observations (GEO)
16-18 July, FAO Headquarters, Rome, Italy

Following the Integrated Global Observations of Land (IGOL) Global Agricultural Monitoring Workshop held at the FAO in March 2006, GEO asked this Ad hoc group to formulate the strategy for GEO Task AG-07-03 – development of an operation agricultural monitoring system; as a contribution to GEO Task AG-06-01 – development of a 10 year strategy for agriculture.

Jeff Tschirley	Chris Justice	Michael Rast
FAO	IGOL Ag Group	GEO Secretariat

The way forward

- **Some refinement of report**
  - Take account of incoming comments
  - Extended conclusions for several sections
  - Improved synthesis of recommendations
  - Refine mapping onto GEO
  - Extension of human settlements to gridded population.
- **Additional efforts post report**
  - Socio-economic observations
  - In situ biophysical properties
  - Water use and availability.
- **Should IGOL as an organization cease its work in near future?**
  - Implementation of most sub-themes has been spun off
    - directly into GEO
    - via existing organizations into GEO
    - via other mechanisms.
  - Need to ensure topography, water and soils recommendations feed into appropriate part of GEO
  - Advice please?

Extra slides

IGOL Report: Scope

- Land cover, land cover change, fire
- Land use, land use change
- Agricultural production, food security, sustainable agriculture and forestry
- Land degradation and soils
- Ecosystems, ecosystem goods and services
- Biodiversity and conservation
- Human health, impacts of land properties on vectors
- Water resource management, water use for agriculture, human use
- Disasters (fires, floods, droughts), early warning systems
- Climate change impacts on land properties
- Energy (biomass, fuelwood)
- Urbanization and infrastructure

Land cover and land cover change

- Develop acquisition strategies for land cover data that optimized coverage in time and space.
- Minimize interruption of fine (30m) resolution data.
- Ensure future continuity of fine resolution multispectral and SAR L-band data.
- **Coordinate radar and optical data acquisition so that radar data can be used for regular, global monitoring of land cover.**
- Agree upon an internationally accepted land cover classification system.
- Coordinate international collection of in situ data for calibration/validation efforts.

Land use and land use change

- Develop a widely accepted land use classification system that is relevant to viability of short- and long-term land uses and also to land potential and sustainability and stratified by low and high land use intensity.
- For intensively used areas, map at 1:500,000 scale mechanized agriculture, pivot irrigation, tropical plantations, areas deforested, and urban areas.
- Integrate remotely sensed and in situ information to map crop production, livestock densities, and fertilizer use.

Biophysical properties

- Space agencies and data providers should continue to generate gridded fAPAR and LAI.
- Reprocessing of available archives of fAPAR and LAI to generate and deliver global, coherent and internationally agreed values.
- Re-analyze the historical archives of NOAA's AVHRR instrument,
  - ensuring the long-term consistency of the product with current estimates throughout the entire period.
- CEOS Working Group on Calibration/Validation should continue to lead international benchmarking and product intercomparison and validation exercises including fAPAR and LAI.
  - Should take full advantage of existing networks of reference sites for in situ measurements whenever possible.

Fire

- **Coordinate an international network of geostationary imagers, providing global active fire detection every 15-30 minutes**
  - make these data available in near real time for fire alert and management.
- **Modify the NPOESS VIIRS sensor for the non-saturated detection and characterization of active fires.**
  - Monthly and near real time burned area products should be included in the operational product suite from NPOESS.
- **Reprocess the AVHRR archive held by NOAA (and NASA),**
  - with correction for known deficiencies in sensor calibration, and for known directional/atmospheric problems.
- **Support a coordinated international effort to validate the current and future global burned area products to CEOS Land Validation Stage 3.**
  - The GOFC/GOLD Regional Networks provide an opportunity for expert product validation
- **Coordinate and target acquisition of data from the international fine resolution assets to provide fine resolution imagery (<20m) of large and hazardous fire events within 48 hours of the event.**
  - The data need to be affordable and easily accessible by the international fire management and research community. Future fine resolution systems should include the capability for active fire detection.
- **Enhance the access to and utility of their fire products,**
  - through the use of near real time delivery systems and web-gis.
- **Implement standardization of national fire data collection and reporting and promote open access to these data.**
  - These data should be spatially explicit and georeferenced.
- **Initiate an international program on Global Fire Early Warning,**
  - integrating satellite and in situ fire weather data.

Biodiversity and Conservation

- **Update world database of protected areas.**
- **Ensure availability and comparability of existing data collections.**
- **Georeference all new socio-economic observations.**
- **Enhance availability of 30m global topography,**
  - which play a critically important role in both correction of imagery data, in habitat delineation, and as model input data.
- **Ensure delivery of very high resolution cloud-free imagery at low cost for rapid response in key areas,**
  - with ability to monitor cloudy areas for illegal logging, road-building in sensitive areas, and so forth.
- **Maintain continuity of long-term seasonal record of land-cover change and fragmentation at 30m resolution.**
  - A key attribute, or derived characteristic of such a land-cover product would be the derivation of disturbance patterns and frequencies.
- **Develop a long-term record of critical land-use characteristics, at a spatial scale that is commensurate with the land-cover change product,**
  - but that includes additional information on the human use of land resources such as crop type at sufficient spatial resolution to identify small land-holders (ca. 0.5 ha).
- **Generate seasonal freshwater distribution and flow data products sufficient to detect irrigation schemes.**
- **Improved models for predicting species distributions on existing landscapes**
  - and develop better guidelines for their use by the scientific community and conservation organizations.
- **Organize observational data from in situ research sites in order to develop a validation database for existing products of relevance to biodiversity issues.**
- **Adopt a consensus ecosystem classification hierarchy and map product**

Agriculture

- Standardize collection and dissemination of annual national statistical and other in situ data.
- Enhance rain gauge data collection network and lower barriers to timely data access.
- Improve seasonal climate prediction accuracy.
- Provide fine resolution (10-20m), cloud free coverage with a 5-10d return period.
- Ensure continuity of moderate resolution (1km, 100-300) observations.
- Improve targeting and reduce costs of very fine resolution (1-3m) imagery.
- Improve spatial resolution, targeting, and height accuracy of radar altimetry and operationalize data collection.
- Provide near real-time access to regularly collected microwave data (10-30m) that can be fused with data from optical systems.

Soils

- Develop harmonized, small-scale (1:1,000,000) soil resource and terrain (SoTeR) database on a global scale.
- Expand quality-controlled, georeferenced soil profile information collection, particularly in areas where none or very little of this information has become available (China, Former Soviet Union).
- Encourage a single body (most logically IUSS), to develop analytical and procedural standard methods that are binding for all organizations involved with soil classification, mapping, and analyses.
- Make interpretations of soil data more accessible and intelligible to non-soil scientists.

Human settlements and socio-economic data

- Devise a classification scheme for built environments, settlements, and infrastructure developments.
- Enhance ability to use ultra-fine spatial resolution data.
- Improve methods for measuring building heights.
- Model spatial distribution of fossil fuel emission.
- Develop the capability to map the distribution and intensity of radio and microwave emission patterns as an indicator of economic activity and income levels.
- Provide enhanced spatial resolution and multiple spectral bands from low light imagery.

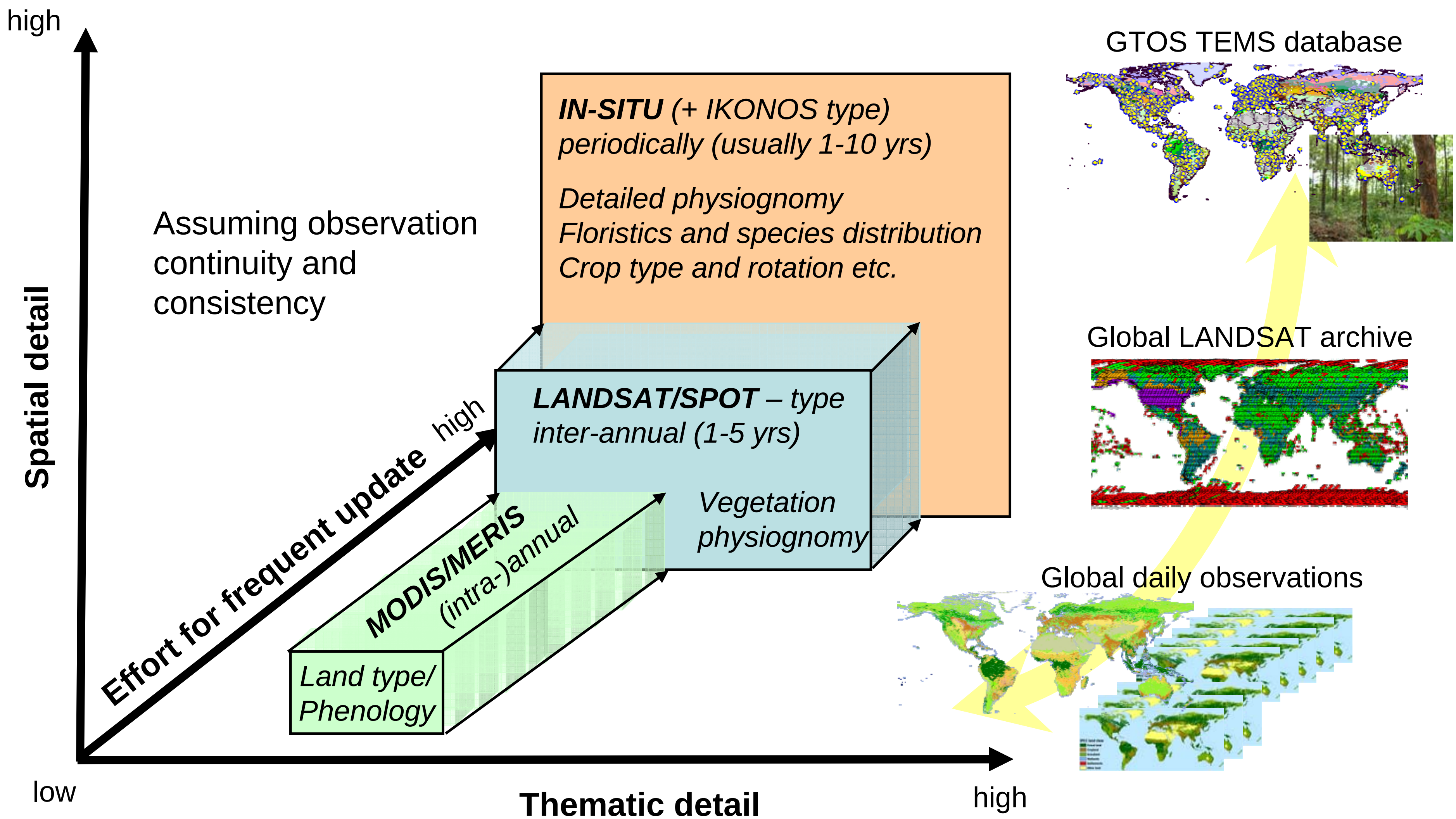
Water availability and use

- Ensure continuity of fine resolution (10-30m) remotely sensed data.
- Test and implement methods to use hyperspectral imaging to measure water clarity.
- Enhance methods to model water use/demand on the watershed scale.
- Map irrigated land area using high and moderate resolution remotely sensed data.

Topography

- Improve global coverage of 90m SRTM datasets
  - possibly by integration with SPOT-5 or ERS acquisitions in tandem mode)
  - especially north of 58 degrees north.
- Ensure public availability of the 30m spacing DEM from the SRTM.
- Provide very high resolution (1m) topographic information for low/flood prone areas
- Distribute data using a common geodetic reference frame.
- Provide terrestrial remote sensing data in an orthorectified form so far as possible.

Integrated and operational observations



Martin Herold